PAN-PACIFIC ENTOMOLOGIST
65(3), 1989, pp. 352–356

Inexpensive, Portable Vacuums Used in Collections of Ants in the Field and Laboratory[1]

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Abstract.—Inexpensive, minor modifications were made to three types of small, portable vacuums for use in collecting ants, particularly carpenter ants. A 4.5-liter canister vacuum was adapted for use with a deep cycle battery for collecting entire ant colonies in the field. Hand-held vacuums were modified for use in the lab to collect small groups of ants, 10–20, for insecticide testing. Use of these modified vacuums made the laborious tasks of collecting, sorting, and counting ants relatively simple and efficient.

Studies involving collections of large numbers of arthropods for repetitive tests using specific numbers of individuals, such as toxicity studies, require apparatuses for rapid and precise collection. Vacuum devices are typically used for this purpose. Vacuuming arthropods avoids the need for anesthesia, cooling, or physical contact, or for volume and weight measurements, and thus reduces damage and mortality in addition to increasing accuracy (Jaycox, 1970).

Many vacuum devices have been designed or modified for the collection of forest canopy insects (Paul and Mason, 1985), bees (Jaycox, 1970; Clinch, 1970; Gary and Marston, 1976; Gary and Lorenzen, 1987), and molluscs and various arthropods (Johnson et al., 1957). These vacuums range from relatively simple (Clinch, 1970; Bradbury and Morrison, 1975) to elaborate designs for specific needs (Gary and Marston, 1976; Gary and Lorenzen, 1987). The costs of these vacuums also vary, depending upon design and necessary modifications. However, most are expensive. One other important aspect to be considered is the flexibility of a system. Some vacuums are easily modified for multiple uses while others are fixed in function. Most of the vacuums described above have been modified from commercially available models by researchers to fit specific needs. However, some vacuums designed for insect collection are commercially available (BioQuip; similar to vacuum described by Gary and Lorenzen, 1987).

We had specific needs for vacuums that were not met by any of the existing designs. Portable vacuums that we modified for the rapid collection of carpenter ants in the field and for ease in handling and counting these ants in the laboratory are described.

[1] This work was conducted under project 0037, Washington State University, College of Agriculture and Home Economics.

Vacuum Modifications

Bon-Aire® "Super Vac" Canister

To collect entire ant colonies in the field, we used a Bon-Aire® "Super Vac" Canister (model BA-747, Bon-Aire Industries, Inc., 3240 Industry Dr., P.O. Box 490, Signal Hill, California 90801) (Fig. 1). The vacuum is provided with a cigarette lighter adapter plug, but for convenience we spliced two battery clamps into the 4.6-m power cord so the vacuum could also be used with a deep cycle battery (18.5 × 22.5 × 16.5 cm, 14.5 kg, 70 amp hr) in the field. The vacuum hose is 90 cm long by 35 mm outside diameter (OD) with a rigid end that connects to the vacuum and a pliable end for suction. This vacuum tank has a full capacity of approximately 4.5 liters. A cloth filter is fitted in the top of the vacuum.

CarVac™ Plus, DustBuster™ Plus, and Hoover Help Mate™ II

Black & Decker CarVac™ Plus, DustBuster™ Plus, and Hoover Help Mate™ II were modified for use in the laboratory to collect small groups of ants, which could be counted easily (Fig. 2). These portable, hand vacuums are very similar, differing mainly in their power source. These vacuums can be readily purchased at auto parts, discount, or hardware stores. The CarVac™ Plus is normally used with a cigarette lighter adapter plug, and the 5-m electrical cord was again equipped with battery clips for use with a 12-volt battery or 12-volt transformer that can be plugged into house current. The DustBuster™ Plus is a rechargeable unit, containing 5 sub c Ni-Cd + batteries. However, we also modified the DustBuster™ Plus with a continuous "on" switch and with the attachment of small alligator clips connected by short wires internally to the system so that accessory battery packs (5 sub c wired in series) can be used after the internal battery packs discharge. Each accessory battery pack will run a unit for an additional 12 min. The Help Mate™ II Model S1059-030 operates on standard 120 AC. The cord is 5.5 m long. If necessary, the filter can be removed from each model to increase suction.

Other Modifications

Modifications of the CarVac™ Plus, DustBuster™ Plus, and Help-Mate™ II were made mainly to the crevice tool which was slightly expanded on the end so the opening was large enough for insertion of a piece of extruded, clear, round, acrylic tubing [15.9-mm outside diameter (OD) by 12.7-mm inside diameter (ID) by 5 cm; Ain Plastics, 800 North 10th, Sacramento, California 95814] (Fig. 2B, C). Any opening remaining in the crevice tool, around the tubing, was tightly sealed with cork cut to fit the openings, if necessary, and glued into place with Duco® or Dow Corning® Silicon Cement to prevent any air leaks. A piece of Tygon® tubing (Fig. 2D; 15.5-mm ID, 21-mm OD) was used to connect the vacuum to a removable end apparatus or collection container for the ants (Fig. 2H). This apparatus consisted of a modified plastic screw-cap specimen jar (118 ml; Carolina Biological Supply Company) which connects to the Tygon® tubing. Holes were cut in the lid with a metal bit in a drill press and in the side of the jar with a heated cork borer for insertion of acrylic tubing (Fig. 2F, I). Small pieces of Tygon® (15.5-mm ID) were placed on either side of the acrylic tubing as it passed through the lid, and the unit was glued into place with Dow Corning® Silicon Cement (Fig. 2J). The acrylic tube inserted through the side of the jar was glued

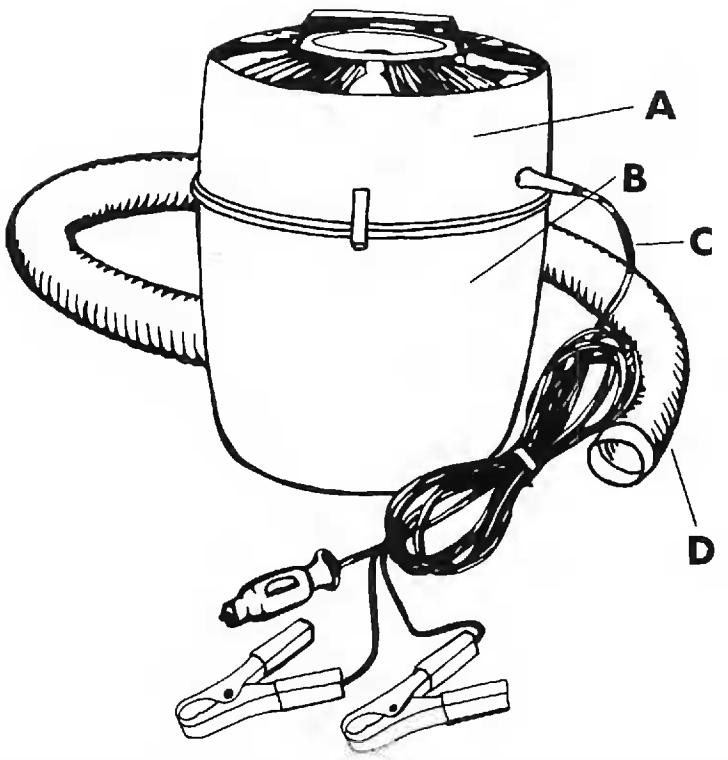

Figure 1. Bon-Aire® "Super Vac" canister. A. Motor housing and filter. B. 4.5-liter tank. C. Cord with cigarette lighter plug and battery clamps. D. Vacuum hose.

into place with hot melt glue (Thermogrip® all purpose hot melt adhesive) and a glue gun. A piece of galvanized steel window screening was inserted in this tube with a short dowel rod until it was flush with the inside edge of the tube (Fig. 2G). This screen prevented suction of ants into the vacuum. The Tygon® tube from the vacuum fits over this tube and is held in place solely by friction so these containers can be replaced rapidly. The tube in the lid was used for sucking ants into the end apparatus. Once a container was filled with the required number of ants, a rubber stopper (#00) was placed in the opening to prevent their escape.

Discussion and Summary

Although we have used many sizes and types of vacuums for collecting carpenter ants since 1976, the Bon-Aire® vacuum is the most effective, portable vacuum of this size we have used for collecting entire colonies of carpenter ants. Since the canister is made of a very smooth plastic with few internal protrusions, ants cannot maintain footing in the vacuum and are easily removed except for a few that may cling to the filter. This makes the periodic emptying of ants into a plastic bag very easy. The vacuum tube is large enough that it infrequently plugs with wood and wood debris, and it is flexible enough that if jams do occur, they are easily cleared. The pliable end of the vacuum hose is desirable because it allows suction of ants that are in narrow crevices in the wood. Two or three of these vacuums are conveniently run simultaneously from a single deep cycle battery. Our battery (70 amp hr) runs two vacuums for a minimum 4 hr, more than enough time to collect multiple colonies on a single collecting trip. The filter needs to be cleaned periodically or removed to maintain optimum suction.

The hand-held portable vacuums are quite similar in design to those by Jaycox (1970), Clinch (1970), and Bradbury and Morrison (1975). There is a benefit in using the CarVac™ Plus or Help Mate™ II vacuum instead of the DustBuster™ Plus model because of the difference in the power source. The DustBuster™ Plus

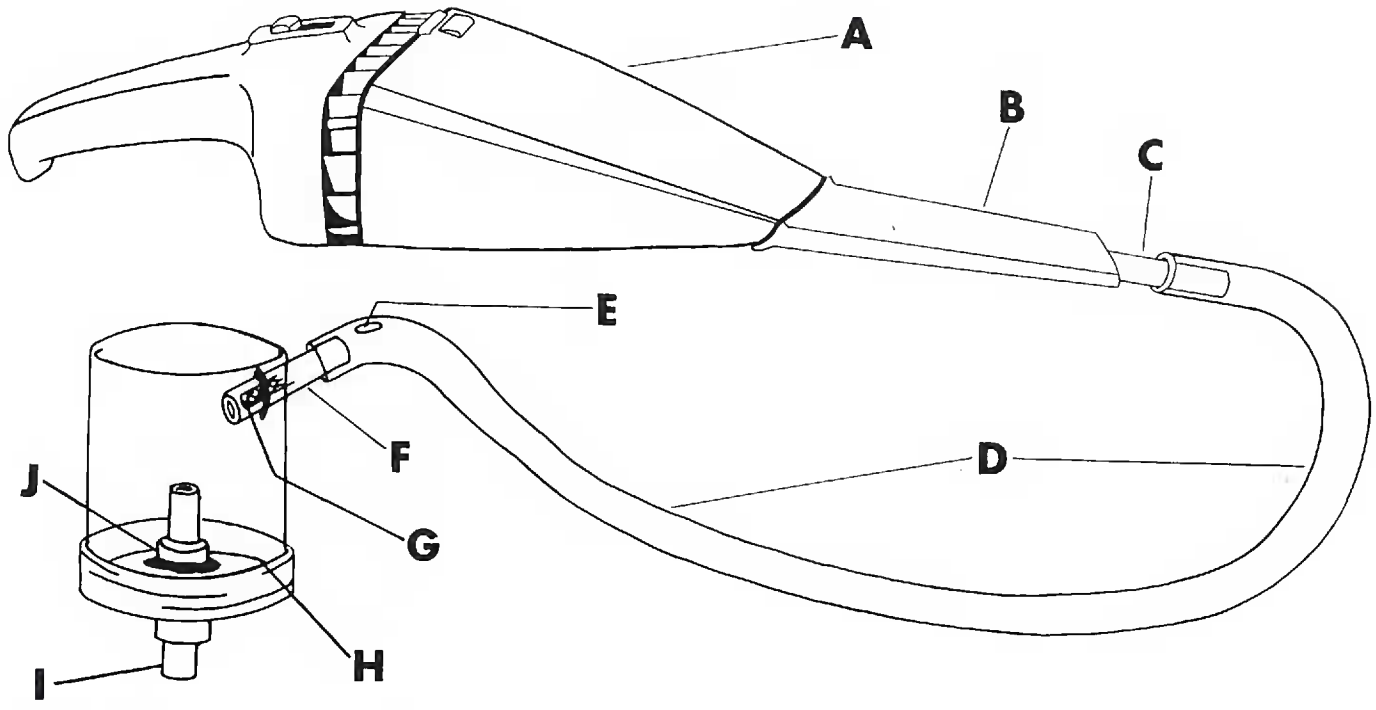

Figure 2. Basic design of Black & Decker 12-volt CarVac® Plus and DustBuster® Plus with an end apparatus (similar modifications were made to crevice tool of the Hoover Help Mate® II). A. Vacuum. B. Crevice tool. C. Round, acrylic tube (15.9 × 12.7-mm OD/ID). D. Tygon® tubing (15.5-mm ID). E. Air vent. F. Round, acrylic tube (15.9 × 12.7-mm OD/ID). G. Screening. H. Specimen jar (118 ml). I. Round, acrylic tube (15.9 × 12.7-mm OD/ID). J. Small piece of Tygon® tubing for support.

can only be used for a short time (15 min) before recharging becomes necessary, but this problem can be minimized if accessory battery packs are used.

The main use of the hand-held vacuums is collecting groups of 10–20 ants into an end apparatus for insecticide testing. It is essential that the end apparatus be made of a rigid, clear plastic material. Flexible plastic materials tend to come unglued easily, but more importantly, the ants cling to them tightly so they cannot be emptied or counted easily. With the slick sides of the container the ants are readily dislodged to the bottom of the container and placed into the testing arena. It is important to place the screen as deeply as possible in the vacuum connection tube of the container so the ants cannot cling to it within the tube. These end apparatus containers are manufactured for about $0.60 each, and we have 100 available when testing. One team member vacuums the required number of worker ants into the containers, filling multiple containers so groups of ants are always available for the next test. If a container breaks or becomes contaminated, it is simply discarded.

Since these vacuums were readily available at very reasonable costs ($14 to $25), and since the modifications required were simple and easily done with few tools, nearly anyone can afford to have one to five vacuums for insect collection and/or insecticide testing. An added benefit to these vacuums is that the modifications do not change the basic designs and all can still be used as a normal vacuum with all their original accessories. Commercially available insect collecting vacuums have limiting factors of cost ($75) and an unalterable design.

Although our primary use of these vacuums has been the collection and manipulation of ants, they can also be used to handle most other insects. Minor modifications to the basic design can make the systems useful for many other functions.

Acknowledgments

We are indebted to Paul Blom, who collected information for this project. Paul Blom, Richard Zack, and Dan Suomi are thanked for critically reading the manuscript and for making suggestions for improvement.

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